Brief #4

This is the fourth brief in a series from CSforAll-MN which provides an overview of computer science (CS) in formal teacher education provided by Minnesota colleges and universities. We hope this brief helps to clarify the opportunities preservice and inservice K-12 teachers have access to within Minnesota higher education institutions.

As the demand for computer science education grows within K-12 classrooms, it is critical that teacher education programs integrate standards-based computer science (CS) and computational thinking (CT) experiences into their programs, and teacher candidates should be required to demonstrate pedagogical content competency in these areas (Rosato et al., n.d.). Early integration within teacher education programs helps preservice and master’s-level and certificate-seeking teachers relate CT and CS to their content courses (Yadav, Mayfield, & Zhou, 2014). Policy issues such as teacher licensure, K-12 state standards for CS education, state standards for effective teaching practice, and funding are hurdles for higher education institutions to offer CS & CT experiences in teacher education programs. Nationally, most training of K-12 educators on CS/CT has focused on preparing inservice educators. In Minnesota that responsibility is mostly delineated to individual districts and organizations to lead due to our limited state-level CS education policies and licensure pathways.

CT/CS in Teacher Education Programs
Less than half (46%) of the survey respondents indicated that CT or CS was a part of their teacher education programs (preservice/inservice). Computational thinking and/or computer science content was more prevalent in the private schools’ responses. Only 1 (20%) of the public schools and 5 (63%) private schools indicated that they include CS and/or CT in their teacher education programs.

Schools that include computational thinking or computer science in their programs do so in both undergraduate-level initial licensure programs and graduate-level certificates, additional licensure, and degree programs. Most schools indicated that the CT/CS inclusion occurred within an educational technology course.

Where MN Teacher Ed Programs Include CT/CS

<table>
<thead>
<tr>
<th>Category</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Undergraduate initial</td>
<td>50%</td>
</tr>
<tr>
<td>Graduate - other</td>
<td>17%</td>
</tr>
<tr>
<td>Graduate endorsement</td>
<td>8%</td>
</tr>
<tr>
<td>Graduate initial license</td>
<td>25%</td>
</tr>
</tbody>
</table>

About the Data

The data used in this brief are from a CSforAll-MN survey distributed in the winter and spring of 2020. This survey was sent to Minnesota Association of Colleges for Teacher Education representatives from 32 different colleges across the state.

Representatives were asked to forward the survey onto the person within their program who could best answer questions about computer science education. CSforAll-MN received 13 responses total that covered topics ranging from what CT/CS experiences are offered in each preservice program to questions about survey respondents’ perceptions of the importance of computer science in K-12 education. Survey respondents represent 8 private and 5 public higher education institutions, including one community college in Minnesota.

Geographically, schools that completed the survey were located most frequently in the Twin Cities and also included northeast, central, southeast, and southwest regions of the state. Survey respondents identified themselves as deans, directors of academic program areas, program coordinators, and teaching faculty.
In the 6 schools that offer CT/CS experiences within teacher education, 2 shared that students create CT/CS lessons within courses. Half of the schools (3) with CT/CS experiences for teachers aligned with the ISTE CT Competencies for Educators and/or with the CSTA Standards for Computer Science Teachers.

Perceptions of Computer Science Education

Almost 70% of survey respondents indicated that all teacher education programs should include CT or CS, whereas the other 30% indicated that CT and CS should be included only in programs for teachers who specialize in CS, STEM, or CTE. Survey participants were also asked to identify the top three reasons why computer science should be taught in K-12 schools. The most frequently identified reasons relate to equity, citizenship, and 21st century skills.

Spotlight: CS Ed in Minnesota Teacher Ed

Dr. Siri Anderson, Director of Graduate Programs for Practicing Teachers at St. Catherine University, developed a 12-credit, 4 class, online Computational Thinking and Coding certificate four years ago for K-12 teachers. The certificate offers 8 possible courses such as: Introduction to Computational Thinking and Coding; Physical Computing: Introduction to Arduinos; Hands on STEM: Animation; Hands on STEM: Maker Spaces. The program has a 97% retention and on-time completion rate with kindergarten teachers through AP biology teachers. Teachers learn how to engage students in authentic computational thinking and coding using unplugged activities, Scratch, Processing, and C++.

Kim Gerst, a software engineer at Best Buy, and Heather Benedict, a technology specialist, designed and teach several of these courses. For six years, Anderson, Gerst, Benedict, and other volunteers offered an extracurricular program for girls aged 8-16 and piloted various approaches to computer science education. They translated what they learned there into the certificate design and courses. Teachers, media specialists, and paraprofessionals with a bachelor’s degree can take these courses to earn the certificate, integrate the courses into a master’s degree, or enroll in them for professional learning.

Additionally, teachers can take professional development courses from curriculum providers CodeHS, Zulama, and CSTA to earn a graduate credit from St. Kate’s EdEx for $150. These curricula and courses have been vetted by St. Kate’s faculty and give teachers experience with curriculum they may use in their own classroom.
A question on the survey asked opinions about what K-12 CS education should look like within schools: CS as a required course for all students, CS offered as an elective, and CS integrated into core courses. Responses were split between options.

**Perspectives on CS within K-12 Education**

- A required course for all students: 5
- Integrated into core courses: 4
- Offered as an elective: 4

The final question (open-ended) on the survey asked schools to identify barriers encountered as well as support needed to include CS/CT within their teacher education programs. The most frequently identified issues are getting buy-in from peer- and leadership-faculty members and preparing them to teach CT/CS courses. Respondents also shared that teacher education programs are already overextended in meeting the state PELSB standards while remaining within the credit cap for their program: “Too many state standards already in place, these do not allow for innovation or adding any areas such as CS.”

Another issue identified by many respondents is the lack of guidance and structure for what a teacher educator program with CT/CS should look like from K-12 schools and the state. The most urgent area of support identified is funding to develop programming, to pay for training of instructors and cooperating teachers, and to pay instructors to teach courses: “We are a small school with a very small number of full-time faculty. Specialized programs like this are difficult for us to offer especially when adjunct pay is so low.”

Looking Forward

There are bright spots in computer science education across Minnesota colleges and universities that primarily serve inservice teachers through master’s level courses and certificate programs. The survey data included in this brief show limited integration of CS/CT education with the state’s teacher education programs, especially at the preservice level. Minnesota colleges and universities need support from the Minnesota licensing and standards board, PELSB, and funding for program development and professional learning in order to integrate CS/CT into teacher education programs.

Future briefs will explore the issues of CS teacher training for K-12 inservice teachers, CS higher education pathways, and CS workforce & industry in Minnesota. In addition, we will share briefs that highlight data from a K-12 MN teacher survey and provide vignettes of local CS offerings happening in Minnesota’s K-12 schools.

**References:**
